Space Weather Technical Forecast

Issued on Tuesday, 16 August 2022 at 12:07 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Ongoing Active electron flux and fluence. G1/Minor storm likely from day 2 (17th). Further Moderate flares (R1-R2 Radio blackouts) likely throughout.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity is Moderate with several M-class flares in the last 24 hours. Three of these were from AR3078 (Dkc/Beta-Gamma-Delta) now located in the southwest quadrant, the largest an M5.0 at 16/0758 UTC.

There are currently five numbered sunspot regions on the visible disc. AR3078 is the largest and most active region and is displaying strong spots with a weak delta configuration. AR3079 and AR3081 are relatively large D regions, with AR3079 maintaining a beta-gamma configuration, and producing an M1 flare on 15th. AR3076 (Cro/Beta in the northwest continues to show decay. AR3074 (Hsx/Alpha), near the southwest limb, remains a simple alpha spot. Three new small sunspots are also in evidence, two regions towards the eastern limb, with the other to the west of AR3078.

There are two modelled CMEs (Coronal Mass Ejections) from the 14th and 15th that have potential to reach Earth on 17th to 18th. A new CME was observed in the early hours (UTC) of 16th, from AR3078, which has been modelled but results are still pending. Updated imagery is also awaited as to whether a further CME was associated with the M5 flare.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by DSCOVR at L1, has declined from around 480m/s to 360km/s. Density remained at average levels. The IMF was weak throughout with the north-south component varying weakly (+/- 4nT). The phi angle was positive (away from the Sun). Geomagnetic activity was Quiet (Kp 1-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV), as measured by GOES16, was at Background levels. The high energy electron flux (greater than 2 MeV) was High, with a peak of 7.58e3 pfu at 15/1550 UTC. The 24-hour integrated electron fluence was above Active threshold throughout, with a rising trend and an observed value of 2.78e8 integrated pfu at 16/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be Moderate and currently there is a chance (15%) for activity to become High if there are any significant M-class flares or X-class flares over the coming days. The most likely source region for these would be from the active sunspot region AR3078, which is now transiting into the southwest quadrant.

Solar Wind / Geomagnetic Activity: Solar winds are expected to be at slow-ambient levels over the next 24 hours. On day 2 (17th), Earth is expected to connect with the high speed stream from coronal hole 14. This enhancement is likely to be further enhanced by at least one

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

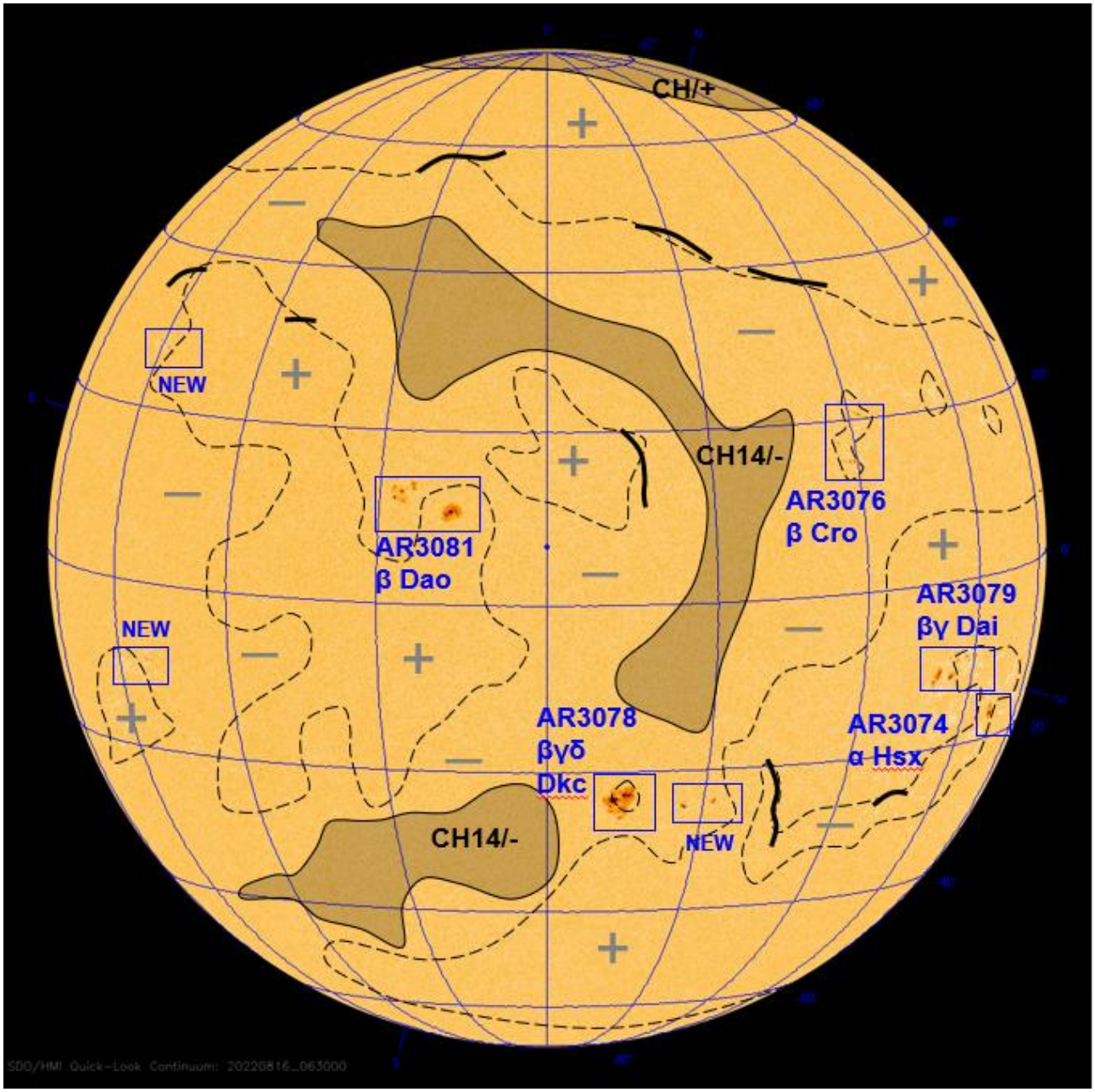
CME arrival, and forecast to impact Earth around the same time frame. Geomagnetic activity is expected to be Quiet, with isolated Unsettled intervals over the next 24 hours. From day 2 (17th), activity is expected to become Unsettled to Active, and G1/Minor Storm intervals likely. There is also a chance of a G2/Moderate Storm in association with the CME arrivals.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is likely to remain at background levels, although with a slight chance of an S1 or greater event. High energy electron flux is expected to continue at a moderate to High (1e3 pfu) levels through day 1 (16th) before becoming suppressed during the course of day's 2 and 3 (17th and 18th). Electron fluence values are forecast to remain above the Active threshold during day 1 (16th), but by day 3 (18th) fluence values are expected to drop below the Active threshold and will probably remain below for the rest of the period.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 1. Solar Analysis Valid 16/0700UTC.



.

Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Geomagnetic Storms:

Solar winds have declined to become slow-ambient levels and are expected to continue at these levels on day 1 (16th). On day 2 (17th) Earth is expected to connect with the high speed stream from coronal hole 14, as it moves into a geo-effective position. This coronal hole is a recurrent feature and solar winds are indicated by persistence to reach similar levels that occurred during the previous rotation, becoming elevated at around 500-600km/s. This enhancement is likely to be further enhanced by the arrival of a CME, which is forecast to impact Earth around the same time frame. Along with this there is a chance of further enhancement due to embedded CME effects, from other CMEs which left the Sun over the past couple of days.

Geomagnetic activity is expected to be Quiet, with isolated Unsettled intervals over the next 24 hours. From day 2 (17th), activity is expected to become Unsettled to Active, and G1/Minor Storm intervals are likely to occur. There is also a chance of a G2/Moderate Storm, most likely when the CME(s) mentioned above impact Earth.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	60	40	20
Strong	G3	No	1	20	10	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

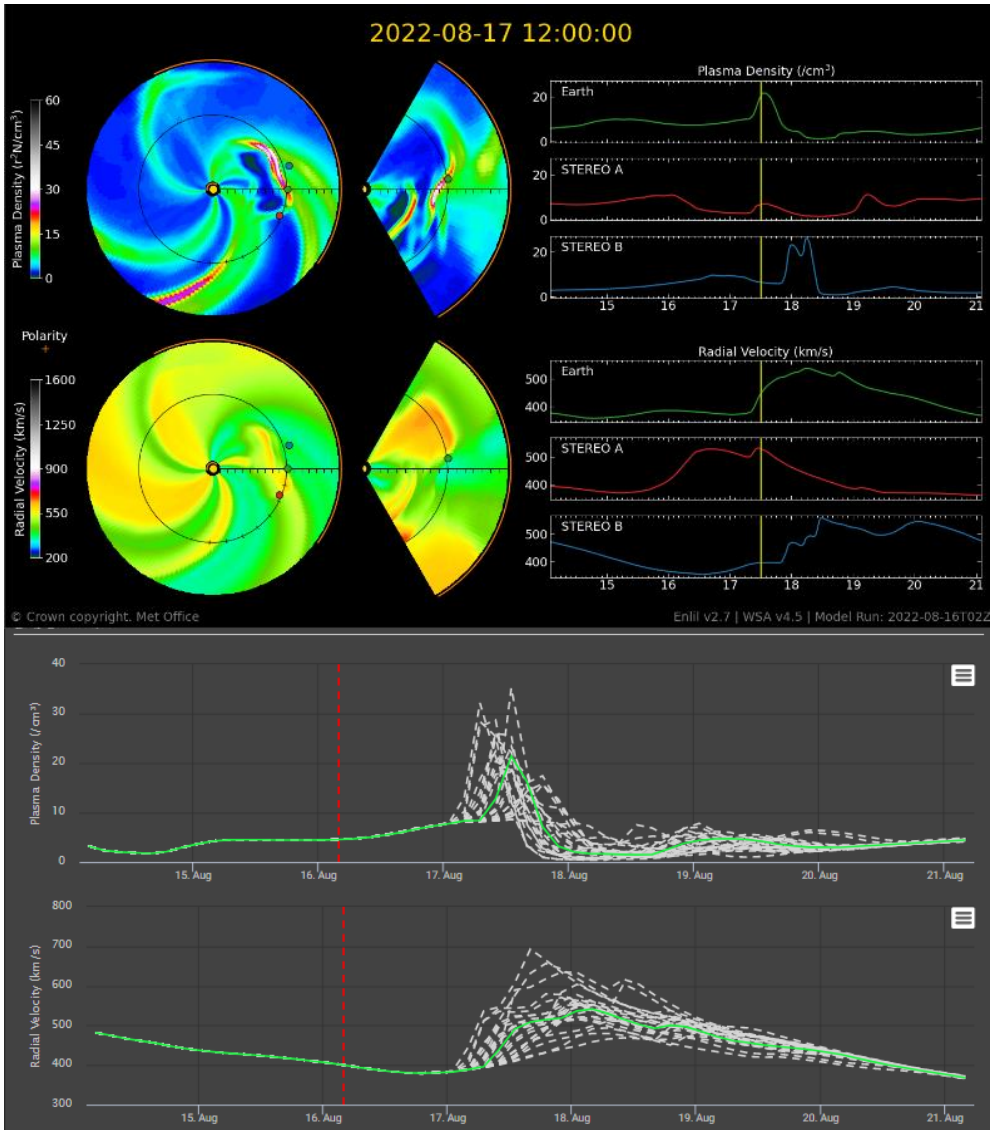
Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
14/1747	Partial Halo	AR3076	NW quadrant	620	17/0600 UTC	Drawn out C-class flare

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 2: Met Office Enlil showing potential CME/s arrival on 17th.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

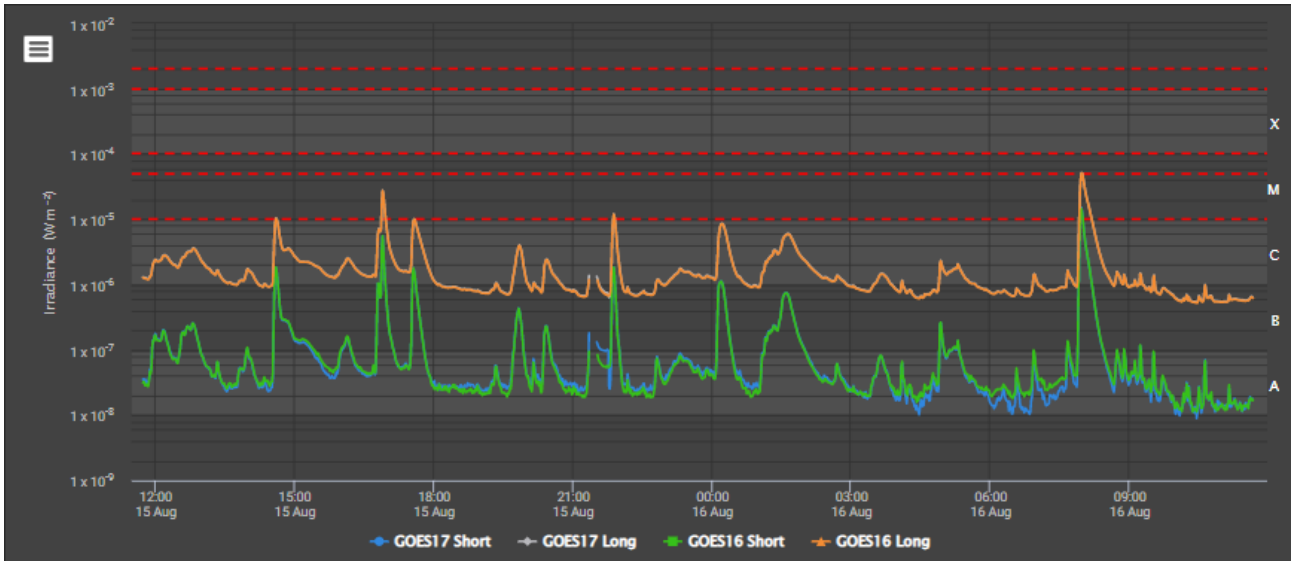
© Crown Copyright 2022. All Rights Reserved.

Radio Blackouts - X-Ray Flares:

Solar activity is forecast to be Moderate and currently there is a chance (15%) for activity to become High if there are any significant M-class flares or X-class flares over the coming days. The most likely source region for these would be from the active sunspot region AR3078 which is transiting to the western hemisphere in the south of the solar disc. There are also other candidates for flaring that need to be considered given their size and magnetic distribution, namely AR3081 (Dai/Beta) in the northeast and AR3079 (Dai/Beta-Gamma) in the southwest. As well as this there are several relatively large filaments which are on the current disc.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	60	60	60	60
Very Active	R3 to R5 X Class	No	15	15	15	15

Figure 3: GOES X-ray flux plot showing recent solar activity.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels, and is likely to remain at this level through the period. AR3078, AR3079 and AR3081 all carry a slight risk of proton events and as they transit further westwards, the risk increases slightly through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	10	10	15	20
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

High Energy Electrons Event (≥ 2MeV):

High energy electron flux (greater than 2MeV) will probably remain at mostly high levels during the next 24 hours. On day 2 (17th), electrons are expected to become suppressed due to the expected increase in geomagnetic activity associated with the arrival of the coronal hole enhancement and the CME(s). A rise towards the High threshold is likely once again later on day 3 and into day 4 (18th and 9th) as geomagnetic activity begins to subside.

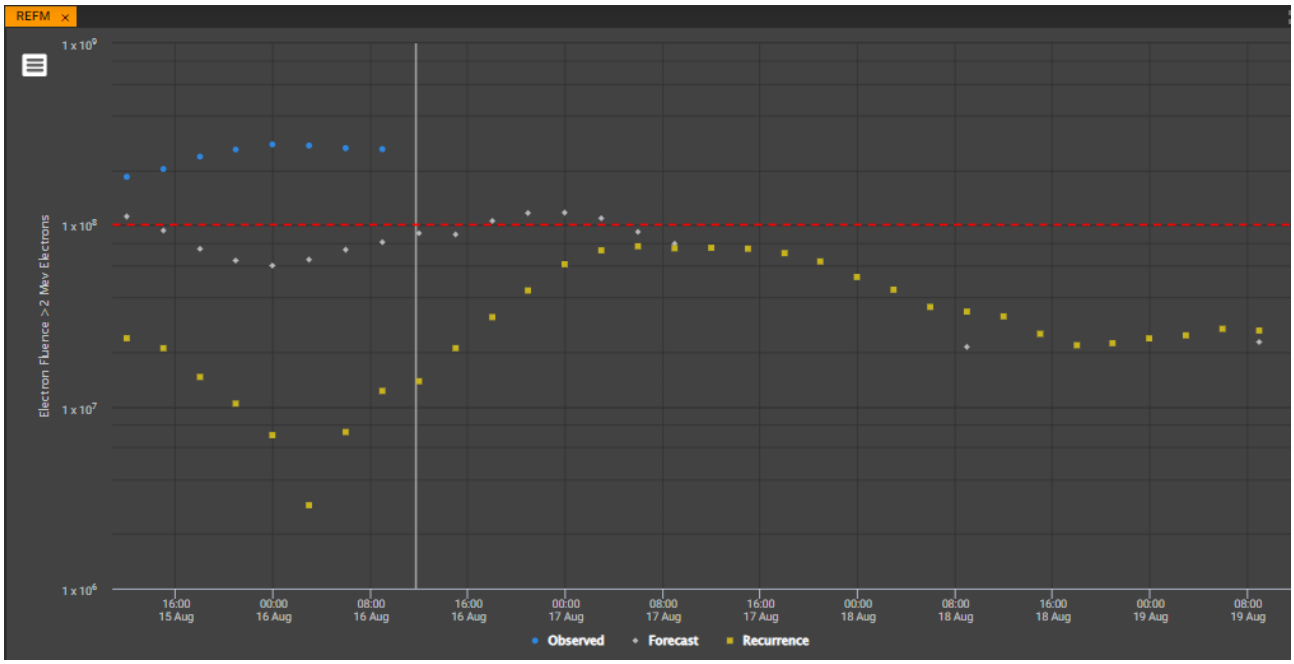
Electron fluence values are expected to remain above the Active threshold through day 1 and into day 2 (16th and 17th), with REFM guidance thought to be slightly too low. During day 2 and into day 3 (17th and 18th) fluence values are currently assessed as likely to drop below the Active threshold.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	Yes	100	90	50	30
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Figure 4: Latest MOSWOC REFM output.



© Crown Copyright 2022. All Rights Reserved.